An Annotated List of Plankton Microrganisms of the Japanese Coast.

BY

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(*With Plates III—VI*).

The following list of plankton microrganisms was drawn up chiefly from the material collected by Mr. Shiibara along the coast of Prov. Tosa in Shikoku during Sept.-Oct. in 1904 and also by myself on the coast of Prov. Bōshyū near the entrance to the Gulf of Tōkyō in May 1906. As may be expected, the material comprise a large number of those forms that occur in the warm Black Current or the "Kuroshiwo."

In the plates I have given figures of all the enlisted species, to illustrate on the one hand what I have observed and on the other hand to aid the students in the work of identification. The process seems to me recommendable in view of the difficulty experienced by the workers in this part of the world in getting access to the literature bearing on the subject. The references I have given under each species in the list are only those I have been able to take into consultation.

I. *Cyanophyceæ.*

1. **Trichodesmium erythræum** Ehrb. (Pl. VI., fig. 45).

Gomont, 1893, p. 216; Pl. V, figs. 27–30.—Wille, 1903, p. 16; fig. 11.

Mr. Shiibara writes me that he had found this plant in great abundance on Aug. 16th, 1906, at a place eighteen miles off the coast of Susaki in Tosa, so that the sea presented a dark reddish colour on account of its presence. He adds that he had seen no fish in the discoloured water.

The filaments (fig. 45*c*) measure 0.0075 mm. in thickness.

Loc. in Japan: Prov. Tosa (Aug. 16th, 1906).

Other known loc.: Red Sea ; Indian, Pacific and Atlantic Oceans.

2. **T. Thiebauti** Gomont. (Pl. VI., fig. 46).

Gomont, 1893, p. 217 ; Pl. VI., figs. 2–4.—Schütt, 1893, p. 40 ; fig. 31 (*Heliotrichum radians* Wille).—Wille, 1903, p. 17 ; fig. 13.

The filaments (fig. 46 *b*) measure 0.006–0.016 mm. in thickness.

Loc. in Japan : Prov. Tosa.

Other known loc. : Indian, Pacific and Atlantic Oceans.

II. *Chlorophyceæ.*

3. **Halosphæra viridis** Schmitz. (Pl. III. fig. 16).

Schmitz, 1887, pp. 67–92 ; Pl. III.—Gran, 1902, p. 12 ; T. I., figs. 10–15.

Loc. in Japan : Shirahama in Prov. Bōshyū.

Other known loc. : Atlantic Ocean ; Mediterranean Sea.

III. *Silicoflagellata.*

4. **Dictyocha fibula** Ehrb. (Pl. III., fig. 10).

Kützing. 1849, pp, 143–144.—Id., 1865, p. 140.—Lemmermann, 1901, p. 260 ; T. X., fig. 24.—Id., 1903, p. 28 ; fig. 92.

Loc. in Japan : Provinces of Tosa, Ise, Mikawa and Bōshyū.

Other known loc.: Baltic Sea, North Sea, Atlantic Ocean, Mediterranean Sea.

5. **D. fibula** Ehrb. var. **stapedia** (Haeckel) Lemm. (Pl. III., fig. 11).

Kützing, 1865, p. 140 ; Pl. XXI., fig. 23.—Lemm., 1901, p. 261.—Id., 1903, p. 29, fig. 96.

Loc. in Japan : Prov. Tosa.

Other known loc. : Atlantic, Pacific and Indian Oceans.

6. **Distephanus speculum** (Ehrb.) Haeckel var. **pentagonus** f. **armata** Lemm. (Pl. III., fig. 12).

Lemm., 1901, p. 264 ; T. XI., fig. 20.

One side of basal ring of the specimen figured measures 0.0225 mm. in length.

Loc. in Japan: Prov. Tosa.
Other known loc.: Italy (fossil).

IV. *Peridiniales.*

7. **Amphisolenia bidentata** Schröder. (Pl. III., fig. 15).
Schröder, 1901, p. 20; Pl. I., fig. 16.
The specimen figured measures: Total length of body ca. 0.1 mm.; thickness of stem in the slender portion 0.0075 mm.; that in the fusiform portion 0.02 mm.; sagittal length of upper valve 0.017 mm.; breadth of marginal list 0.0075 mm.
Loc. in Japan: Prov. Tosa.
Other known loc.: Mediterranean Sea; Indian Ocean.

8. **Blepharocysta splendor maris** Ehrb. (Pl. V., fig. 34).
Schütt, 1896, p. 24; fig. 34.
Diameter of the specimen figured measures 0.064 mm.
Loc. in Japan: Prov. Tosa.
Other known loc.: Red Sea.

9. **Ceratium lineatum** (Ehrb.) Cleve var. **longiseta** Ostf. and Schm. (Pl. III., fig. 7).
Ostf. and Schm., 1901, p. 163; fig. 12.
Loc. in Japan: Provinces of Tosa and Shima.
Other known loc.: Red Sea.

10. **C. gravidum** Gourr. (Pl. III., fig. 5).
Gourr., 1883, p. 58; Pl. I., fig. 15.
Okam. and Nishikawa, 1904, p. 127; Pl. VI., fig. 21.
Loc. in Japan: Provs. Tosa and Bōshyū.
Other known loc.: Indian Ocean; Atlantic Ocean: Mediterranean Sea.

11. **C. limulus** Gourr. (Pl. III., fig. 8).
Gourr., 1883, p. 33; Pl. I., fig. 7.
The specimen figured measures: Height of body 0.064 mm.; breadth

0.052 mm.; thickness in side view 0.026 mm.; length of apical horn 0.04 mm.

Loc. in Japan: Tateyama in Prov. Bōshyū (May, 1906).

Other known loc.: Atlantic and Indian Oceans.

12. **C. contortum** (Gourr.) Cleve. (Pl. III., fig. 4).

Cleve, 1900 a, p. 14; Pl. VII., fig. 10.—Gourr., 1883, p. 35; Pl. II. fig. 33 (*C. gibberum var. contortum*)—Okam. and Nishikawa, 1904, p. 124; Pl. VI., fig. 9.

Loc, in Japan: Prov. Tosa; Kushimoto in Prov. Kii (Nishikawa).

Other known loc.: Mediterranean Sea; Indian and Pacific Oceans; Also, west of Africa and east of South America.

13. **C. gibberum** Gourr. (Pl. III., fig. 3).

Gourr., 1883, p. 34; Pl. II., fig. 35.—Id., p. 36; Pl. II., fig. 34 (*C. gibberum var. sinistrum*).

Height as well as breadth of body about 0.09 mm., as measured on the specimen figured in figs. 3 b and c.

Loc. in Japan: Prov. Tosa.

Other known loc.: Naples.

14. **C. hexacanthum** Gourr. var. **contortum** Lemm. (Pl. III., fig. 9).

Lemm., 1899, p. 347; Pl. II., figs. 20-21.

Loc. in Japan: Prov. Tosa.

Other known loc.: Atlantic Ocean (Barber).

15. **C. neglectum** Ostf.? (Pl. IV., fig. 22).

Ostf., 1903, p. 584; fig. 135?

Loc. in Japan: Prov. Isé.

Other known loc.: Faerŏes Isl.

16. **C. macroceras** Ehrb., f. (Pl. IV., fig. 19).

The individual observed resembled much that which is figured in Ostf. and Schm., 1901, p. 167, fig. 19.

Loc. in Japan: Prov. Shima.

17. **C. macroceras** Ehrb., f.? (Pl. IV., fig. 20).

The curvature and direction of antapical horns are as in typical *C. macroceras*; but, I am not sure if the latter has the apical horn and

antapicals in one and the same plane as is the case in the specimens observed by me. For sake of future comparison I have given two figures of the present form. Possibly a distinct species.

Loc. in Japan: Prov. Tosa.

18. **C. horridum** (Cleve) Gran. (Pl. IV., fig. 21; fig. 23 (abnormal form)).

Gran, 1902, p. 194.—Ostf., 1903, p. 584; figs. 136–139—Cleve, 1897, p. 302; fig. 4 (*C. tripos* v. *horrida*).—Schütt, 1893, p. 70; fig. 35, IV. (*C. tripos* var. *scotica*)—Jörgensen, 1900 b, p. 42; Pl. I., fig. 10. (*C. tripos* var. *macroceras* f. *intermedia*)—Okam. and Nishikawa, 1904, p. 122; Pl. VI., fig. 5. (*C. arcuatum?* or *C. longipes?*).

In accordance with Ostenfeld's view, I have referred the several forms shown in figs. 21 *a-h* to *C. horridum*. Most of the forms seem to represent f. *intermedia* (*a-c*); and if it be justifiable to give a name to the rest (*d-h*), I shall call these f. *laevis*. Schröder has illustrated, in his "Phytoplankton des Golfs von Neapel," Taf. I., fig. *h-n*, various forms of *C. tripos* var. *macroceras*, all of which may be made, I think to belong to this species.

The specimen figured in fig. 23 seems to me to be an abnormal form probably of this species having two right antapical horns instead of one.

Loc. in Japan; Provinces of Bōshyū (May), Shima (Feb.), and Tosa.

Other known loc.: Atlantic and Indian Oceans.

19. **C. ranipes** Cleve. (Pl. III., fig. 6.)

Cleve, 1900 a, p. 15; Pl. VII., fig. 1.—Id., 1901, p. 230.—Schröder, 1901, p. 16; Taf. 1, fig. o-p.—Okam. and Nishikawa, 1904, p. 124; fig. 12.

Loc. in Japan: Prov. Bōshyū (May); Kushimoto in Prov. Kii (Nishikawa).

Other known loc.: Tropical Atlantic; in the Equatorial, the Antilles and the Florida current; around the Azores.

20. **C. vultur** Cleve. (Pl. III., fig. 1.)

Cleve, 1900 a, p. 15; Pl. VII., fig. 5.—Ostf. and Schm., 1901, p. 167; fig. 20.—Okam. and Nishikawa, Pl. VI., fig. 8.

As will be seen from the figures given, the uppermost individual in a

chain differs somewhat from the lowest with respect to the angular flexure and the gentle curvature of antapical horns, especially of the left one. Should the lowest individual (i.e., the lowest in the figure and the one having longest apical horn) be set free, it may readily be taken for a form of other species of *Ceratium*. It is in some measure distinguished from related forms by a stouter form of body and horns. The apical horn shows low insignificant lists along its ridges.

Loc. in Japan: Prov. Tosa.

Other known loc.: Caribbean Sea; Bahamas; Indian Ocean.

21. **C. volans** Cleve. (Pl. IV., fig. 18).

Cleve, 1900 a, p. 15; Pl. VII., fig. 4.—Ostf. and Schm., 1901, p. 168; fig. 21.

I have referred all the forms illustrated in figs. 18, *a-d*, to this species, considering that shown in fig. *e* to be typical, on account of the angular flexure of antapical horns. If I am right in this identification, it is to be considered that the individuals are subject to variation in some measure with respect to the direction and curvature of antapical horns, figs. *a* and *d* representing two extreme cases. Fig. *a* much resembles *C. patentissimum* with which this species agrees in the smallness of body. It may be doubted if the original of fig. *d* is referable to the present species, on account of the great approach made by the antapical horns toward the apical one.

Loc. in Japan: Provs. of Bōshyū and Tosa.

Other known loc.: Atlantic and Indian Oceans.

22. **C. patentissimum** Ostf. and Schm. (Pl. III., fig. 2).

Ostf. and Schm., 1901, p. 168; fig. 22.

Loc. in Japan: Provs. of Bōshyū and Tosa.

Other known loc.: Red Sea.

23. **C. hirundinella** f. **piburgense** Zederb. (Pl. IV., fig. 24).

Zederb., 1904, p. 5; T. V., figs. 8–12.

The specimen figured measures: length of apical horn 0.08 mm.; length of the right, of the left and of the middle antapical horns,

0.045 mm., 0.0375 mm., and 0,0525 mm. respectively; breadth of girdle, 0.06 mm.

Loc. in Japan: Lake Chūgūzi (Nikko; Nov., 18, 1904).

Other known loc.: Europe.

24. **Ceratocorys horrida** Stein. (Pl. IV., fig. 25).

Schütt, 1896, p. 26; fig. 37.—Murr. and Whitt., 1899, p. 329; Pl. XXX. fig. 5.

The specimen figured measures: length and breadth of body ca. 0.06 mm.; length of wing 0.06–0.075 mm.; breadth of marginal list 0.025 mm.

Loc. in Japan: Prov. Tosa.

Other known loc.: Mediterranean Sea; Pacific and Indian Oceans.

25. **Dinophysis homunculus** Stein. f. **pedunculata** Schm. (Pl. V., fig. 40).

Schm., 1901, p. 220, fig. 8.

Total length of body in the specimen shown in fig. 40 *b* measures 0.082 mm.; breadth, 0.037 mm.; length of the lower prolongation, 0.026 mm., and breadth of same, 0.013 mm.

Loc. in Japan: Provs. of Bōshyū (May) and Tosa.

Other known loc.: Mediterranean Sea; Indian and Pacific Oceans.

26. **D. Vanhöffenii** Ostf. (Pl. V., fig. 41).

Cleve, 1899, p. 39; Pl. IV., fig. 7.—Id.; 1900 a, p. 16; Pl. VIII., fig. 3.—Id., p. 926; fig. 8.—Jörgensen, 1901, p. 19; Pl. III., fig. 33. (*D. acuminata* var. *granulata*).

Dimensions of the specimen represented in fig. 41 *b*, are ca. 0.04 mm. by 0.033 mm.; those of *c*, 0.04 mm. by 0.03 mm.

Loc. in Japan: Prov. Shima.

Other known loc.: Northern Atlantic; Arctic Sea; Davis Strait; Yedo Bay (Cleve).

27. **Diplopsalis lenticula** Bergh. (Pl. V., fig. 44).

Schütt, 1896, p. 21; fig. 31 A-C.

Loc. in Japan: Prov. Tosa.

Other known loc.: Azores and Red Sea.

28. **Gonyaulax polyedra** Stein. (Pl. V., fig. 35).

Schütt, 1896, p. 21 ; fig. 29.—Jörgensen, 1900 b, p. 34.

Height and breadth (wing exclusive) of the specimen figured are ca. 0.0675 mm.

Loc. in Japan : Prov. Tosa.

Other known loc. : Baltic Sea ; Atlantic Ocean ; Pacific Ocean.

29. **G. polygramma** Stein. (Pl. III., fig. 13).

Nishikawa, 1901–1903, p. 32.

In Nov., 1902, the *Gonyaulax* made sudden appearence in great abundance in the Gulf of Isé and on Sept. 26, 1903, swarms of spores, probably of this species, came into observation in Aguwan, near the Gulf of Isé. They gave the water a reddish colour ; hence the phenomenon is known to fishermen under the name of " aka-shiwo," i.e., " red-tide," as Mr. Nishikawa has already described in his paper quoted above.

30. **Ornithocercus magnificus** Stein. (Pl. IV., fig. 27).

Schütt, 1896, p. 29 ; fig. 41.—Id., 1900, p. 18 ; figs. 8-10.—Murr. and Whitt., 1899, p. 332 ; Pl. 32, fig. 2. (*Histioneis magnifica*).

Specimen figured measures : Height of body ca. 0.05 mm ; breadth of body ca 0.06 mm. ; length of one of the longer nerves in the sail 0.06 mm. ; height of marginal list ca. 0.03 mm.

Loc. in Japan : Prov. Tosa.

Other known loc. : Atlantic and Indian Oceans.

31. **Peridinium spinulosum** Murr. and Whitt. (Pl. III., fig. 14).

Murr. and Whitt., 1899, p. 328 ; Pl. XXIX., fig. 8.

Height of body in specimen figured measures 0.04 mm. ; breadth 0.035 mm.

Loc. in Japan : Prov. Tosa.

Other known loc. : Atlantic Ocean.

32. **P. conicum** (Gran) Ostf. and Schm. (Pl. V., fig. 36).

Ostf. and Schm., 1901. p. 174.—Gran, 1902, p. 189 ; fig. 14.—Jörgensen, 1900 b, p. 37 (*P. lenticulare* var. *michaelis*).

Height of body of the specimen figured measures ca. 0.09 mm.; breadth, ca. 0.08 mm.

Loc. in Japan: Prov. Tosa; Shinoshima in Prov. Owari.

Other known loc.: Atlantic Ocean; Red Sea.

33. **P. tumidum** Sp. nov. (Pl. V., fig. 37).

This species, which is characterised by the swollen body and by the possession of a list stretched between the bases of antapical horns, is so nearly related to *Peridinium elegans* that one might consider it simply a variety of the latter species; but there exist differences in the shape and size of body, in the absence of teeth at the bases of antapical horns and in the almost horizontal girdle. In *P. elegans*, as known to me (fig. 38, a. l.), the list stretching between the bases of antapical horns is visible, but not so manifestly as in the present species.

Loc. in Japan: Prov. Tosa.

34. **P. elegans** Cleve. (Pl. V., fig. 38).

Cleve, 1900 a, p. 16; Pl. VII., figs. 15, 16.—Murr. and Whitt, 1899, Pl. XXIX., f. 4 a.

Cleve gives in his Atlantic Plankton Organisms, Pl. VII., fig. 16, a side view of this species, in which figure the body is represented so thick that the thickness much exceeds the breadth; perhaps this may be a misrepresentation.

The specimen figured measures: height of body taken from the apex of apical horn to the tooth at the base of an antapical horn, 0.09 mm.; breadth of body, 0.083 mm.; thickness, 0.045 mm.

Loc. in Japan: Prov. Tosa.

Other known loc.: Atlantic and Indian Oceans; Red Sea.

35. **P. diabolus** Cleve. (Pl. V., fig. 39).

Cleve, 1900 a, p. 16; Pl. VII., fig. 20.—Murr. and Whitt., 1899, Pl. XXIX, f. 4 b.

Ostf. and Schm., 1901, p. 174.

Length of apical horn in the specimen figured measures ca. 0.037 mm.; that of one of the antapical horns, 0.037 mm; height of body, 0.09 mm.; breadth of same, 0.11 mm.

Loc. in Japan : Prov. Tosa.

Other known loc. : Atlantic Ocean.

36. **Phalacroma Mitra** Schütt. (Pl. V., fig. 43.)

Schütt, 1896, fig. 38 A and C.—Murr. and Whitt., 1899, Pl. XXXI., fig. 7.

Height of body in the specimen figured measures 0.08 mm. ; length of sagittal axis, ca. 0.07 mm.

Loc. in Japan : Prov. Tosa.

Other known loc. : Atlantic Ocean.

37. **P. sp.** (Pl. V., fig. 42).

This species seems much to resemble *P. minutum* Cleve (Atlantic Plankton Organism., p. 18, Pl. VIII., figs. 10-11); it measures somewhat less than 0.056 mm. in height and 0.052 mm. in breadth.

Loc. in Japan : Tateyama in Prov. Bōshyū (June 23, 1906).

38. **P. sp.** (Pl. IV., fig. 26).

The species I am unable to determine with the literature at my disposal. Its size is as follows: height of body 0.09 mm.; breadth 0.075 mm., and thickness 0.07–0.075 mm. *P. porodictyum* Stein?

Loc. in Japan : Prov. Tosa.

39. **Prorocentrum micans** Ehrb.? (Pl. IV., fig. 28).

The size of the specimen figured is as follows : length of body 0.057–0.06 mm. ; breadth 0.017–0.02 mm ; length of spine 0.0087–0.015 mm.

Loc. in Japan : Prov. Tosa.

V. ***Murracytae.***

40. **Pyrocystis pseudonoctiluca** Murr. (Pl. V., fig. 29).

Murr., 1895, fig. 57.—Schütt, 1896, fig. 2 A.—Blackman, 1902, p. 179; Pl. IV., figs. 1–5.

Diameter : 0.418 mm.

Loc. in Japan : Prov. Bōshyū (May-Aug.)

Other known loc.: Red Sea; Indian and Pacific Oceans; tropical Atlantic.

41. **P. fusiformis** Murr. (Pl. V., fig. 30).

Murr., 1895, fig. 57 c.—Blackman, 1902, p. 183; Pl. IV., fig. 9.

Dimensions: 0.9 mm. by 0.25 mm.

Loc. in Japan: Prov. Bōshyū (May); Tosa.

Other known loc.: Red Sea; Atlantic Ocean.

42. **P. lanceolata** Schröder. (Pl. V., fig. 31).

Schröder, 1901, p. 13; Taf. I., fig. 11.—Blackman, 1902, p. 187; Pl. IV., fig. 9.?

Length of body in the specimen figured measures 1.033 mm.; breadth in the broadest part, 0.09 mm.; breadth in the narrower part 0.03 mm.

Blackman had remarked that he has not discovered any difference between this species and *P. fusiformis*.

Loc. in Japan: Prov. Tosa.

Other known loc.: Naples.

43. **P. lunula** Schütt. (Pl. V., fig. 32).

Schütt, 1896, p. 3; fig. 2. B–F.—Blackman, 1902, p. 184; Pl. IV., fig. 8.—Hensen, 1887, p. 78; Taf. IV., fig. 30 (Cyst of *Gymnodinium*).

Breadth of body in the specimen represented in fig. 32 a. measures 0.055 mm.

Loc. in Japan: Provs. of Tosa and Isé.

Other known loc.: Atlantic and Indian Oceans; Mediterranean Sea and Red Sea.

44. **P. hamulus** Cleve. (Pl. V., fig. 33).

Cleve, 1900 a, p. 19; Pl. VII., fig. 23.—Blackman, 1902, p. 184; Pl. IV., fig. 5–7.

In my material, two individuals form an entire circle measuring 0.45 mm. in diameter and 0.02 mm. in thickness of horn.

Loc. in Japan: Prov. Tosa.

Other known loc.: Atlantic and Indian Oceans.

VI. *Tripylea* (*Radiolaria*).

45. **Aulosphaera labradoriensis** Borgert. (Pl. VI., fig. 48).

Borgert, 1901, p. 16; fig. 15, a-b.

In the specimen figured, dimensions are as follows: length of "Tangential röhren," 0.13 mm.; its thickness, 0.0037 mm.; length of "Radialstacheln," 0.113 mm.; its thickness near base, 0.0082 mm.

Loc. in Japan: Tateyama in Prov. Bōshyū (June, 2. 1906).

Other known loc.: Atlantic Ocean.

46. **Cannosphaera geometrica** Borgert. (Pl. VI., fig. 47).

Borgert, 1901, p. 25; fig. 25.

Diameter of inner shell in the specimen figured measures 0.05 mm.; that of outer shell, 0.248 mm.; length of inner radial beam, 0.086 mm.; that of outer radial beam, 0.08 mm.

Loc. in Japan: Shirahama in Prov. Bōshyū (May, 30, 1906).

Other known loc.: Irminger Sea.

47. **Protocystis xiphodon** (Haeckel) Borgert. (Pl. III., fig. 17).

Borgert, 1901, p. 27; fig. 28.—Haeckel, 1886, p. 1648 (*Challengeria xiphodon*).—Hensen, 1887, p. 79.—Möbius, 1887, p. 121; Taf. VIII., figs. 41–42.—Jörgensen, 1900 b, p. 91.

Loc. in Japan: Prov. Shima.

Other known loc.: Mediterranean Sea; Atlantic Ocean.

VII. *Tintinnodea* (*Infusoria*).

48. **Dictyocysta templum** Haeckel. (Pl. VI., fig. 55).

Brandt, 1906, T. III., fig. 1.—Jörgensen, 1900 a, p. 40.—Daday, 1886–87, p. 585; T. XXI., figs 8–9.—Entz, 1886, p. 415; 2, p, 208, T. XIV., figs. 18–21, 23.

In the specimen figured, total height of body measures 0.625 mm.; height and diam. of neck ring, 0.0225 mm., and 0.0375 mm. respectively; and diam. of body, 0,045 mm.

Loc. in Japan: Prov. Tosa.

Other known loc.: Atlantic Ocean; Red Sea; Madagascar; Guinea Stream.

49. **Codonella ostenfeldi** Schmidt. (Pl. VI., fig. 53).

Brandt, 1906, Taf. 14, figs. 1, 2; Taf. 15, fig. 2.—Cleve, 1901, p. 9; Pl. VII., fig. 15 (syn.? *Cod. fenestrata*).

Loc. in Japan: Prov. Tosa.

Other known loc.: Borneo.

50. **C. morchella** Cleve. (Pl. VI., fig. 54).

Cleve, 1899 a, p. 969, fig.—Brandt, 1906, Taf. XIII., figs 1–3; Taf. XIV., figs. 3–6; Taf. XV., fig. 1.

The specimen figured in fig. 53 b. measures: height of proboscis 0.0225 mm.; diam. of mouth 0.0245 mm.; diam. of base of proboscis 0.03 mm.; length and breadth of house 0.045 mm.

Loc. in Japan: Shirahama in Prov. Bōshyū (May, 30, 1906); Prov. Tosa.

Other known loc.: Atlantic and Indian Oceans; Red Sea.

51. **Tintinnopsis lobiancoi** v. Daday. (Pl. VI., fig. 56.)

v. Daday, 1886–87, p. 553; T. 19, f. 27.—Brandt, 1906, Taf. 26, figs. 7–8.

Diam. of mouth in the specimen figured measures 0.035–0.038 mm.; that of basal part, 0.03 mm.; and length of house, 0.16–0.203 mm.

Loc. in Japan: Prov. Tosa.

Other known loc.: Atlantic Ocean.

52. **T. fracta** Brandt. (Pl. VI., fig. 57.)

Brandt, 1906, p. 4; T. XXIII., figs. 1, 3–5, 9–13.

The specimen shown in fig. *a* measures: diam. of mouth, 0.033–0.04 mm.; breadth of basal portion, 0.036 mm., and length, 0.232 mm. In fig. b: diam. of mouth, 0.045 mm.; length (in curved state), 0.12 mm.

Loc. in Japan: Prov. Tosa.

Other known loc.: Borneo, Bombay.

52. **T. aperta** Brandt. (Pl. VI., fig. 58).

Brandt, 1906, p. 4; T. XXV., figs. 2, 7, 9, 10–12.

Diam. of mouth of the tubular process in the specimen figured measures 0.0175 mm.; its length, 0.045 mm.; diam. of the swollen part 0.025 mm.; and total length of house excluding the lower process, 0.07 mm.

Loc. in Japan: Prov. Tosa.

Other known loc.: Tocantins (Brazil), Loanda (Africa).

54. **T. tubulosa** Levander em. Brandt. (Pl. VI., fig. 59).

Brandt, 1906, Taf. XXIV., figs. 5, 8, 10-11.

The specimen shown in fig. *a* measures: length, 0.075 mm.; mouth, 0.025 mm.; and the swollen part 0.03 mm. In fig. *b*; 0.085 mm., 0.0275 mm. and 0.0375 mm. respectively.

Loc. in Japan: Prov. Tosa.

Other known loc.; Nordquist.

55. **T. Davidoffi** v. **cylindrica** v. Daday (?) Brandt. (Pl. VI., fig. 60).

Brandt, 1906, Taf. XXV., figs. 1, 3-6, 8.

Mouth and length in the specimen figured measures 0.049 mm. and 0.16 mm. respectively.

Loc. in Japan: Prov. Tosa.

Other known loc.: Atlantic Ocean.

56. **T. mortenseni** Schmidt. (Pl. VI., fig. 65.)

Brandt, 1906, Taf. XXI., fig. 13.

The specimen figured measures: mouth, 0.07 mm.; diam. of the tubular part, 0.03 mm.; and height, ca. 0.05 mm.

Loc. in Japan: Prov. Tosa.

Other known loc.: Tocantins (Brazil).

57. **T. nordquisti** Brandt. (Pl. VI., fig. 61).

Brandt, 1906, Taf. XXIV., figs. 1-4.

The specimen figured measures: mouth, 0.042 mm.; basal part of tube, 0.026 mm.; diam. of basal opening, 0.09 mm.; and height, 0.03 mm.

Loc. in Japan: Prov. Tosa.

Other known loc.: Tocantins (Brazil), Borneo.

58. **T.** sp. (*T. campanula* Ehrb. var. ?) (Pl. VI., fig. 62).

Mouth in the specimen figured measures 0.045 mm.; basal part, 0.03 mm.; and height, 0.0825 mm.

Loc. in Japan: Prov. Tosa.

59. **T.** sp. (*T. campanula* Ehrb. var. ?) (Pl. VI., fig. 63).

Mouth, 0.027 mm.; height, 0.04 mm.

60. **T.** sp. (*T. campanula* Ehrb. var. ?) (Pl. VI., fig. 64).

The specimen figured measures: Mouth, 0.045 mm.; middle portion, 0.03 mm.; basal part, 0.0375 mm.; and height, 0.075 mm.

Loc. in Japan: Prov. Tosa.

61. **Cyttarocylus Ehrenbergii** (Clap. et Lachm.) Fol. (Pl. VI., fig. 49).

Brandt, 1906, Taf. XLI., figs. 2–4.—v. Daday, 1886–87, p. 583.—Jörgensen, 1900 a, p. 36.

The specimen figured in fig. *a*. measures: diam. of mouth, 0.09 mm.; length of house, 0.14 mm.; and length of basal process, 0.034 mm.; in fig. *b*: diam. of mouth, 0.067 mm., and length of house, 0.142 mm.

Loc. in Japan: Shirahama in Prov. Bōshyū (May, 27, 1906).

Other known loc.: Atlantic Ocean.

62. **C. Ehrenbergii** (Clap. et. Lachm.) var. **claparedei** (v. Daday) Brandt. (Pl. VI., fig. 50).

Brandt, 1906, Taf. XLI., figs. 1, 5.—v. Daday, 1886–87, p. 582; Taf. XXI., figs. 5, 16 (*C. claparedii*)—Jörgensen, 1900 a, p. 37; Taf. III., figs. 31, 22. (Syn.? *C. Ehrenbergii* (Clap. et Lachm.) Fol. v. *subannulata*).

The specimen figured measures: diam. of mouth, 0.09 mm.; total length of house, 0.25 mm.; broadest diameter of house, 0,0975 mm. at middle portion; length of lower process, ca. 0.09 mm.; and thickness of wall, 0.00375 mm.

Loc. in Japan: Prov. Shima.

Other known loc.: Atlantic Ocean.

63. **Ptychocylis undella** (Ostf. & Schm.) Brandt. (Pl. VI., fig. 51).

Brandt, 1906, LIX., figs. 1–5 ; Taf. LXI., figs. 1–8.—Ostf. and Schm., 1901, p. 181 ; fig. 30. (*Cyttarocylus undella*).

Loc. in Japan : Prov. Tosa.

Other known loc. : Red Sea and Atlantic Ocean.

64. **P. (Rhabdonella) spiralis** (Fol.) Brandt var. (Pl. VI., fig. 52).

Brandt, 1906, Taf. LII–LIII. ; Taf. LIV (part).

Loc. in Japan : Prov. Tosa.

65. **Tintinnus mediterraneus** Mereschk. v. longa Brandt? (Pl. VI., fig. 66).

Brandt, 1906, Taf. LXV., figs. 6–8?

Mouth in the specimen figured measures 0.02 mm. in diam., and height, 0.06 mm.

Loc. in Japan : Prov. Tosa.

66. **T. fraknoi** v. Daday. (Pl. VI., fig. 67).

v. Daday, 1886–87, p. 528 ; Pl. XVIII., fig. 1.—Brandt, 1906, Taf. LXV., figs. 9, 10, 13, 16–18, 20.

The specimen figured in fig. *a* measures : mouth, 0.0375 mm. ; basal part, 0.024 mm. ; and length, 0.165 mm. In fig. *b*, 0.05 mm., 0.03 mm., and 0.3 mm., respectively.

67. **T. acuminatus** Clap. et Lachm. (Pl. VI., fig. 68).

Entz, 1886, p. 201 ; Taf. XIV., fig. 13.—v. Daday, 1886-87, p. 532 ; Taf. XVIII., fig. 6.—Möbius, 1887, p. 10 ; Taf. VIII., fig. 37.—Brandt, 1906, Taf. LXVII., figs. 1, 9.—Jörgensen, 1900 a, p. 8, Taf. I., fig. 1.

Length and breadth near neck measure in the specimen figured 0.3 mm and 0.02 mm. respectively.

Loc. in Japan : Prov. Tosa.

Other known loc. : Atlantic Ocean and Mediterranean Sea.

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Postscript.

At a time when the printing of the present paper was nearly finished, I have received Schröder's interesting work "Beiträge zur Kenntnis des Phytoplanktons warmer Meere" kindly sent me by the author. In that paper, a number of *Ceratium* species, mostly from the Pacific, are described as new. I regret to say that I differ from him with regard to the status assigned to several of the species put down by him. It will be admitted by all that the organisms in question are subject to very considerable variation as to their morphological characters. Thus, as I have mentioned in the text, even the two individuals at the ends of one and the same *Ceratium* chain may differ in the curvature and the direction of antapical horns to such an extent, that when observed singly and separately their specific identity may be placed in doubt (see fig. 1, Pl. III.). Nearly equally striking is the variation shown by *C. gibberum* (figs. 3 *a-d*) in the curvature of the right antapical horn. The same may further be said of *C. volans* (fig. 18, Pl. IV) and of *C. horridum* (figs. 21 *a-f*). Taken all in

all, it seems to me that such characters as the length of horns or the manner of curvature in their course, unless exceptionally pronounced, are by themselves altogether too unsafe features to base specific distinction on. Of much greater importance for the purpose seem to me to be the general form and rigidity of body as well as the angular flexure and the direction of horns at origin. Basing myself on this standpoint, I venture to put down the following comparative table between the *Ceratium* species described or mentioned by Schröder (left column) and those set forth by me in the present paper (right column).

Ceratium subcontortum Schröder = *C. contortum* (Gourr.) Cleve (Pl. III, fig. 4).

C. saltans Schröder = *C. gibberum* Gourr. (Pl. III. fig. 3).

C. Okamurai Schröder = probably *C. horridum* f. (Pl. IV, fig. 21*b*).

C. aequatoriale Schröder = a form of *C. vultur* Cleve (e.g. the lower one of two shown in Pl. III, fig. 1).

C. ceylanicum Schröder = *C. patentissimum* Ostf. and Schm. (Pl. III, fig. 2).

C. elegans Schröder = *C. patentissimum* Ostf. and Schm. (Pl. III, fig. 2)

C. Hundhauseni Schröder = *C. volans* Cleve (Pl. IV, fig. 18*c*).

C. palmatum Schröder = probably *C. ranipes* Cleve (Pl. III, fig. 6).

Pyrocystis hamulus Cleve var. *semicircularis* Schröder = *P. hamulus* f.

Explanation of Figures in Pl. III.—VI.

Plate III.

Fig. 1. **Ceratium vultur** Cleve. From Prov. Tosa.
a, individuals in a chain ; ×97.
b, the uppermost individual of above ; ×220.
c, two consecutive individuals from the lower end of the chain ; ×220.

Fig. 2. **C. patentissimum** Ostf. and Schm.
a, from Prov. Bōshyū ; ×97.
b, from Prov. Tosa ; ×56.
c. portion of the same specimen as *b*, more highly magnified ; ×97.

Fig. 3. **C. gibberum** Gourr. From Prov. Tosa.
a, a specimen ; ×97.
b, another specimen in frontal view ; ×220.
c, same as fig. *b*. in dorsal view ; ×220.
d, still another specimen ; ×220.
e, same as *c*, viewed from the apex ; ×220.

Fig. 4. **C. contortum** (Gourr.) Cleve. From Prov. Tosa.
a, dorsal view ; ×220.
b, ventral view of another specimen ; ×220.

Fig. 5. **C. gravidum** Gourr. Body seen from side ; ×97. From Prov. Bōshyū.

Fig. 6. **C. ranipes** Cleve. From Prov. Bōshyū. × ca. 220.

Fig. 7. **C. lineatum** v. **longisetum** Ostf. and Schm.
a and *b*, two specimens from Prov. Shima ; ×390.

Fig. 8. **C. limulus** Gourr. From Gulf of Tateyama in Prov. Bōshyū.
a, dorsal view ; ×390.
b, side view of same ; ×390.

Fig. 9. **C. hexacanthum** Gourr. v. **contortum** Lemm. From Prov. Tosa.

a, body seen from the left side ; × 175.

b, dorsal view of same ; × 97.

(The extremity of the left antapical horn broken and dilated.)

Fig. 10. **Dictyocha fibula** Ehrb. From Prov. Tosa. × 600.

Fig. 11. **D. fibula** var. **stapedia** (Haeckel) Lemm. From Prov. Tosa. × 600.

Fig. 12. **Distephanus speculum** (Ehrb.) Haeckel v. **pentagonus** f. armata Lemm. From Prov. Tosa. × 390.

a, seen from below.

b, same seen from side.

Fig. 13. **Gonyaulax polygramma** Stein. *a* and *b*, from Gulf of Isé ; *c* and *d*, from Aguwan in Prov. Shima.

a, ventral view ; × 600.

b, apical view of same ; × 600.

c and *d*, spores, probably of this species ; × 600.

Fig. 14. **Peridinium spinulosum** Murr. and Whitt. From Prov. Tosa. × 600.

a, dorsal view.

b, ventral view of same.

Fig. 15. **Amphisolenia bidentata** Schröder. From Prov. Tosa.

a, entire body ; × 140.

b, apical portion of body ; × 600.

c, frontal view of the lower end of body ; × 600.

d, side view of same ; × 390.

Fig. 16. **Halosphaera viridis** Schm. From Shirahama in Prov. Bōshyū.

a, cell in living state ; × 56.

b, one of chromatophores, moderately magnified.

Fig. 17. **Protocystis xiphodon** (Haeckel) Borgert. From Prov. Shima.

a, body ; × 220.

b, part of reticulation ; × 600.

Plate IV.

Fig. 18. **Ceratium volans** Cleve. *a*—*c*, from Prov. Tosa; *d*—*e* from Gulf of Tateyama in Prov. Bōshyū.
a—*c*, different forms of C. volans; *a*, *d*, *c*, ×97; *b*, *c*, ×56.

Fig. 19. **C. macroceras** Ehrb. f. From Prov. Shima (February, 3, 1904). ×140.

Fig. 20. **C. macroceras** Ehrb. f.? From Prov. Tosa. ×97.
a, body seen from the side of left antapical horn.
b, seen from the ventral side of same.

Fig. 21. **C. horridum** (Cleve) Gran.
a, *b*, *c*,—f. *intermedia* (*a*, ×140; *b*, ×144; *c*, ×97).
d, *e*, *f*, *g*, *h*,—f. *laevis* n. f. (*d*, *f*, *g*, *h*, ×97; *e*, ×220).
a, *b*, *d*, *f*, *h*, from Prov. Bōshyū (May); *c*, from Prov. Shima (Feb.); *e*, *g*, from Prov. Tosa.

Fig. 22. **C. neglectum** Ostf.? Specimen obtained from Prov. Isé (Feb. 11, 1904) somewhat broken. ×390.

Fig. 23. **C. horridum** (Cleve) Gran; abnormal form. From Prov. Bōshyū. ×140.

Fig. 24. **C. hirundinella** f. **piburgense** Zederbauer. From Lake Chūguji (Nikko). ×390.

Fig. 25. **Ceratocorys horrida** Stein. From Prov. Tosa.
a, lateral view; ×390.
b, same seen from above; ×390.
c, same seen from below; ×200.

Fig. 26. **Phalacroma sp.** From Prov. Tosa. ×220.
a, body seen from lower end.
b, right side view of same.
c, ventral view of same.

Fig. 27. **Ornithocercus magnificus** Stein. From Prov. Tosa.
a, Left side view; ×390.
b, right side view of same; ×220.
c, ventral view; diagrammatic, slightly magnified.

Fig. 28. **Prorocentrum micans** Ehrb.? From Prov. Tosa. × 390.
a, shell devoid of contents.
b, another specimen with contents.

Plate V.

Fig. 29. **Pyrocystis pseudonoctiluca** Murr. From Prov. Bōshyū. × 97.

Fig. 30. **P fusiformis** Murr. From Prov. Bōshyū (May, 23, 1905).

Fig. 31. **P. lanceolata** Schröder. From Prov. Tosa.
Cell, × 97 ; above, an extremity magnified 600 times.

Fig. 32. **P. lunula** Schütt.
a and *c*, from Prov. Tosa, × 220 ; *b*, from Prov. Isé, × 600.

Fig. 33. **P. hamulus** Cleve. From Prov. Tosa. × 97.

Fig. 34. **Blepharocysta splendor maris** Ehrb. From Prov. Tosa. × 390.
a, body seen from below ; *b*, ventral view of same ; *c*, dorsal view of same ; *d*, apical view of same.

Fig. 35. **Gonyaulax polyedra** Stein. From Prov. Tosa. × 220.

Fig. 36. **Peridinium conicum** (Gran.) Ostf. and Schm. From Prov. Tosa. × 390.

Fig. 37. **P. tumidum** Sp. nov. From Prov. Tosa.
a, × 220 ; *b*—*e*, × 97.
a and *d*, dorsal view.
b and *c*, ventral view of same ; *e*, right side view of same.

Fig. 38. **P. elegans** Cleve. From Prov. Tosa.
a, ventral view showing the membranous list, *l* ; × 220.
b, dorsal view of another specimen ; × 390.
c, side view of same ; × 390.

Fig. 39. **P. diabolus** Cleve. From Prov. Tosa. × 220.

Fig. 40. **Dinophysis homunculus** Stein f. **pedunculata** Schm.
a, one of the two jointed together ; from Prov. Bōshyū ; × 390.
b, more robust form, with 1–3 teeth-like elevations on the lower extremities, *c* and *d* ; from Prov. Tosa ; × 390.

Fig. 41. **D. Vanhöffenii** Ostf. From Prov. Shima.
a, right-side view ; ×390.
b, dorsal view of the same specimen ; ×600.
c, another specimen ; ×600.

Fig. 42. **Phalacroma** sp. From Tateyama in Prov. Bōshyū. ×390.
a, lateral ; *b*, dorsal ; *c*, ventral views of a specimen.

Fig. 43. **P. Mitra** Schütt. From Prov. Tosa.
a, lateral ; *b*, ventral views of a specimen ; ×390.

Fig. 44. **Diplopsalis lenticula** Bergh. From Prov. Tosa.
a, lateral ; *b*, dorsal ; *c*, *d*, ventral views of a specimen ; the last fig. as seen in a slightly oblique direction ; ×390.

Plate VI.

Fig. 45. **Trichodesmium erythraeum** Ehrb. From Prov. Tosa.
a, plants in nat. size, with three tufts of filaments, *b*, enlarged ; ×56.
c, filaments ; ×600.

Fig. 46. **T. Thiebautii** Gomont. From Prov. Tosa.
a, tuft in nat. state ; ×56.
b, filaments ; ×390.

Fig. 47. **Cannosphaera geometrica** Borgert. From Shirahama in Prov. Bōshyū. ×140.

Fig. 48. **Aulosphaera labradoriensis** Borgert. From Tateyama in Prov. Bōshyū.
a, fragment ; ×97. *b*, "Radial stacheln ;" ×600.
c—*d*, two knots of the network "Tangential röhren" ; ×390.

Fig. 49. **Cyttarocylus Ehrenbergii** (Clap. et Lachm.) Fol. From Shirahama in Prov. Bōshyū.
a, ×390 ; *b*, ×220.

Fig. 50. **C. Ehrenbergii** (Clap. et Lachm.) var. d. **Claparedei** (v. Daday) Brandt. From Prov. Shima.
a, ×220 ; *b*, portion of reticulation, ×660.

Fig. 51. **Ptychocylis undella** (Ostf. and Schm.) Brandt. From Prov. Tosa; ×390.

Fig. 52. **P. (Rhabdonella) spiralis** (Fol.) Brandt var. From Prov. Tosa. × ?

Fig. 53. **Codonella ostenfeldi** Schm. From Prov. Tosa.
a, ×220; *b*, ×390.

Fig. 54. **C. morchella** Cleve.
a, From Shirahama in Prov. Bōshyū; ×390. *b*, from Prov. Tosa; ×390.

Fig. 55. **Dictyocysta templum** Haeckel. From Prov. Tosa.
a, ×600; *b*, house seen from below, ×340.

Fig. 56. **Tintinnopsis lobiancoi** v. Daday. From Prov. Tosa. ×390.

Fig. 57. **T. fracta** Brandt. From Prov. Tosa. ×390.

Fig. 58. **T. aperta** Brandt. From Prov. Tosa. ×600.

Fig. 59. **T. tubulosa** Levander em. Brandt. From Prov. Tosa.
a, ×390; *b*, ×600.

Fig. 60. **T. Davidoffi** var. **cylindrica** v. Daday (?) Brandt.
a, ×97; *b*, the same as *a*, ×390. Both from Prov. Tosa.

Fig. 61. **T. nordquisti** Brandt. From Prov. Tosa. ×390.

Fig. 62. **T.** sp. From Prov. Tosa. ×390.

Fig. 63. **T.** sp. From Prov. Tosa. ×600.

Fig. 64. **T.** sp. From Prov. Tosa. ×390.

Fig. 65. **T. mortensenii** Schm. From Prov. Tosa. ×220.

Fig. 66. **Tintinnus mediterraneus** Mereschk. var. **longa** Brandt? From Prov. Tosa. ×600.

Fig. 67. **T. fraknoi** v. Daday. From Prov. Tosa.
a, ×390; *b*, ×220.

Fig. 68. **T. acuminatus** Clap. et Lachm. From Prov. Tosa. ×340.